1 468 148

PATENT SPECIFICATION

(11) 1 468 148

(21) Application No. 59450/72 (22) Filed 22 Dec. 1972
(61) Patent of addition to No. 1316256 dated 2 June 1970
(23) Complete Specification filed 26 Feb. 1974
(44) Complete Specification published 23 March 1977
(51) INT CL² H02K 3/02 3/04
(52) Index at acceptance
H2A 2E4Y 2E9 5X 8D2 8X 9B 9D

(72) Inventors PHILIP RICHARDSON and ANTHONY DEREK APPLETON

(19)

(54) WINDINGS FOR DYNAMO-ELECTRIC MACHINES

(71) We, C. A. PARSONS & COMPANY LIMITED, a British Company, of Heaton Works, Newcastle upon Tyne 6, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to windings for dynamo-electric machines and is particularly concerned with subdivided conductors for such windings.

The present invention is an improvement in or modification of the invention disclosed and claimed in copending U.K. Patent Application No. 27909/69 (now Patent No. 1316256).

The present invention consists in a dynamo-electric machine provided with an armature winding having a stranded conductor, in which at least some of the strands are ducted strands of composite construction, the ducted composite strands each comprising one or more elements of a first type of material of high electrical conductivity having a resistivity of less 3×10^{-8} ohm-metre, said one or more elements extending along the strand and forming the principal conductive portion or portions of the strand and one or more elements of a second type of material of substantially greater mechanical strength, having a 0.2% proof stress greater than 30,000 pounds per square inch, than said first type of material, said one or more material is provided with at least one longitudinally disposed duct for the flow therethrough of cooling fluid.

The invention still further consists in a machine as set forth in any of the preceding three paragraphs wherein at least one longitudinally disposed duct for the flow therethrough of cooling fluid is formed in part by at least one of the elements of the first type of material and in part by at least one of the elements of the second type of material.

The invention still further consists in a machine as set forth in any of the preceding four paragraphs, wherein the second type of material is steel.

The invention still further consists in a machine as set forth in any of the first four of the preceding five paragraphs, wherein the second type of material is a rigid plastics material.

The invention still further consists in a machine as set forth in any of the preceding six paragraphs, wherein said one or more elements of the second type of material are bonded to the elements of the first type of material at interfaces between elements along the strand.

The invention still further consists in a machine as set forth in the preceding paragraph, wherein there is provided a longitudinally extending uninterrupted liquid-proof duct inherently formed in the strand and passing therethrough and adapted to convey a liquid coolant through the strand

ERRATUM

SPECIFICATION NO 1468148

Page 1, Heading (61) *delete* whole line

THE PATENT OFFICE
5 May 1978

Bas 45119/2

1 468 148

PATENT SPECIFICATION

(11) 1 468 148

(21) Application No. 59450/72 (22) Filed 22 Dec. 1972
(61) Patent of addition to No. 1316256 dated 2 June 1970
(23) Complete Specification filed 26 Feb. 1974
(44) Complete Specification published 23 March 1977
(51) INT CL² H02K 3/02 3/04
(52) Index at acceptance
H2A 2E4Y 2E9 5X 8D2 8X 9B 9D

(72) Inventors PHILIP RICHARDSON and ANTHONY DEREK APPLETON

(19)

(54) WINDINGS FOR DYNAMO-ELECTRIC MACHINES

(71) We, C. A. PARSONS & COMPANY LIMITED, a British Company, of Heaton Works, Newcastle upon Tyne 6, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to windings for dynamo-electric machines and is particularly concerned with subdivided conductors for such windings.

The present invention is an improvement in or modification of the invention disclosed and claimed in copending U.K. Patent Application No. 27909/69 (now Patent No. 1316256).

The present invention consists in a dynamo-electric machine provided with an armature winding having a stranded conductor, in which at least some of the strands are ducted strands of composite construction, the ducted composite strands each comprising one or more elements of a first type of material of high electrical conductivity having a resistivity of less 3×10^{-8} ohm-metre, said one or more elements extending along the strand and forming the principal conductive portion or portions of the strand and one or more elements of a second type of material of substantially greater mechanical strength, having a 0.2% proof stress greater than 30,000 pounds per square inch, than said first type of material, said one or more elements of said second type of material also extending along the strand and imparting rigidity to the strand.

The invention further consists in a machine as set forth in the preceding paragraph, wherein at least one of the elements of the first type of material is provided with at least one longitudinally disposed duct for the flow therethrough of cooling fluid.

The invention still further consists in a machine as set forth in either of the two preceding paragraphs, wherein at least one of the elements of the second type of material is provided with at least one longitudinally disposed duct for the flow therethrough of cooling fluid.

The invention still further consists in a machine as set forth in any of the preceding three paragraphs wherein at least one longitudinally disposed duct for the flow therethrough of cooling fluid is formed in part by at least one of the elements of the first type of material and in part by at least one of the elements of the second type of material.

The invention still further consists in a machine as set forth in any of the preceding four paragraphs, wherein the second type of material is steel.

The invention still further consists in a machine as set forth in any of the first four of the preceding five paragraphs, wherein the second type of material is a rigid plastics material.

The invention still further consists in a machine as set forth in any of the preceding six paragraphs, wherein said one or more elements of the second type of material are bonded to the elements of the first type of material at interfaces between elements along the strand.

The invention still further consists in a machine as set forth in the preceding paragraph, wherein there is provided a longitudinally extending uninterrupted liquid-proof duct inherently formed in the strand and passing therethrough and adapted to convey a liquid coolant through the strand.

The invention still further consists in a machine as set forth in any of the preceding eight paragraphs and comprising a plurality of strands arranged in concentric circular series around a central strand.

The invention also consists in a dynamo-electric machine provided with an armature winding having stranded electrical conductors substantially as described herein-below with reference to any of the accompanying drawings, of which:—

Figure 1 shows a cross-sectional view of a composite strand for a stranded conductor

SEE ERRATA SLIP ATTACHED

of the armature winding of a dynamo-electric machine in accordance with one form of the present invention in which a highly electrically conductive material in the strand is split into several elements, and

Figures 2 and 3 show strands according to two further embodiments of the invention.

In each of the Figures, reference numeral 1 refers to a material of high electrical conductivity, reference numeral 3 refers to an electrical insulator, reference numeral 4 refers to a material of higher mechanical strength than the material referred to by reference numeral 1 where advantages are gained if the material has lower electrical conductivity than the material referred to by reference numeral 1, and reference numeral 5 refers to a region which is left vacant as a duct for coolant.

By the expression high electrical conductivity in respect of the material referred to by numeral 1 is meant a material having an electrical resistivity of less than 3×10^{-8} ohm-metre, and by the expression higher mechanical strength in respect of the material referred to by numeral 4 is meant a material having a 0.2% proof stress greater than 30,000 pounds per square inch.

Referring first to Figure 1, this shows a cross-section through a composite strand for a machine in accordance with one form of the invention, being one strand of a plurality of strands together forming a stranded conductor for an armature winding in a dynamo-electric machine. In a dynamo-electric machine of the turbo-alternator type having a high electric loading, the armature winding may comprise stranded conductors having each strand of a conductor insulated from adjacent strands to minimise losses due to eddy currents and the conductors may be disposed in slots in the stator or in a cylindrical air-gap in the machine.

The strand shown in Figure 1 comprises a plurality of segments 1 of a material of high electrical conductivity as hereinbefore defined, preferably copper, bonded to the exterior of an element 4 of higher mechanical strength as hereinbefore defined in the form of a tube of rectangular cross-section so as to provide a longitudinal cooling fluid duct 5 running through the centre of the strand.

The strengthening tube 4 may be composed, for example, of steel, or of a rigid plastics material having a tensile strength adequate to satisfy the definition above.

In the alternative embodiment of the invention shown in Figure 2, the tube of high strength material 4, has a circular cross-section.

It should be noted that in any of the embodiments so far or hereinafter described, the high strength material may have moderate or low electrical conducting properties or be electrically insulating, but reduction of eddy current losses is improved if this material has low electrical conductivity or is an electrical insulator.

Figure 3 shows a single strand having six elements of high conductivity material 1 arranged around a fluted core tube of high strength low conductivity material 4 having a central duct 5 for cooling fluid. The fluted form of the tube is so designed that the conducting elements 1 are matched in shape to give maximum heat transfer. Each conducting element 1 is electrically insulated from the others and from the tube 4 by insulation 3. The conductors may be held in position either by an insulating tape binding or a thin walled tube 7 of low conductivity. The tube 7 may be swaged in the course of assembly.

The elements 1 are preferably arranged around tube 2 helically, and/or a number of strands may be arranged in one or more concentric circular series around a central strand.

WHAT WE CLAIM IS:—

1. A dynamo-electric machine provided with an armature winding having a stranded conductor, in which at least some of the strands are ducted strands of composite construction, the ducted composite strands each comprising one or more elements of a first type of material of high electrical conductivity having a resistivity of less than 3×10^{-8} ohm-metre, said one or more elements extending along the strand and forming the principal conductive portion or portions of the strand, and one or more elements of a second type of material of substantially greater mechanical strength, having a 0.2% proof stress greater than 30,000 pounds per square inch, than said first type of material, said one or more elements of said second type of material also extending along the strand and imparting rigidity to the strand.

2. A machine as claimed in Claim 1, wherein at least one of the elements of the first type of material is provided with at least one longitudinally disposed duct for the flow therethrough of cooling fluid.

3. A machine as claimed in Claim 1 or 2, wherein at least one of the elements of the second type of material is provided with at least one longitudinally disposed duct for the flow therethrough of cooling fluid.

4. A machine as claimed in Claim 1, 2 or 3, wherein at least one longitudinally disposed duct for the flow therethrough of cooling fluid is formed in part by at least one of the elements of the first type of

material and in part by at least one of the elements of the second type of material.

5. A machine as claimed in any one of the preceding claims, wherein the second type of material is steel.

6. A machine as claimed in any one of Claims 1 to 4, wherein the second type of material is a rigid plastics material.

7. A machine as claimed in any one of the preceding claims, wherein said one or more elements of the second type of material are bonded to the elements of the first type of material at interfaces between elements along the strand.

8. A machine as set forth in Claim 7, wherein there is provided a longitudinally extended uninterrupted liquid-proof duct inherently formed in the strand and passing therethrough and adapted to convey a liquid coolant through the strand.

9. A machine as claimed in any one of the preceding claims and comprising a plurality of strands arranged in concentric circular series around a central strand.

10. A dynamo-electric machine provided with an armature winding having stranded electrical conductors substantially as described with reference to any of the accompanying drawings.

MARKS & CLERK.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1977
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1468148 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

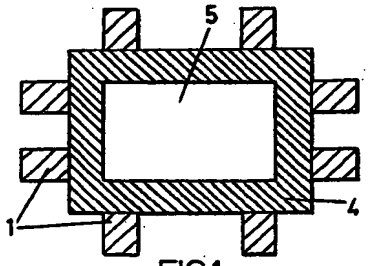

FIG.1

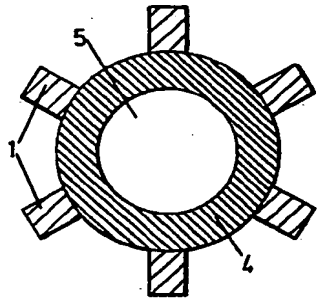

FIG.2

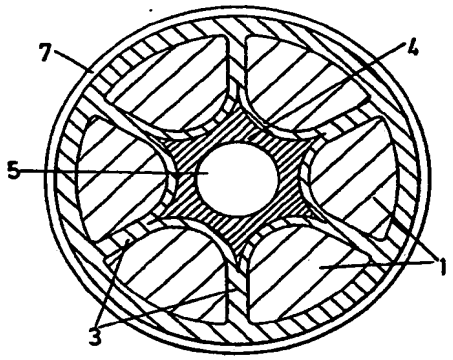

FIG.3